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The antihistamine-PAB validation study was completed during the reporting period. Preliminary analysis of the results indicates that Benadryl and Seldane produced different effects on different tests of the battery. Benadryl produced more profound effects than Seldane on both accuracy and speed of responding. This laboratory also participated in the testing and evaluation of version 2.1 of the UTC-PAB software systems. The information obtained, along with standards specifications for certain PAB component tasks was provided to the Director, JWGDS MILPERF.

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FOREWORD

For the protection of human subjects, the investigator(s) have adhered to policies of applicable Federal Law 45CFR56.

Citations of commercial organizations and trade names in this report do not constitute an official Department of the Army endorsement or approval of the products or services of these organizations.

SUMMARY

The Environmental Medicine Department (EMD) at the Naval Medical Research Institute (NMRI) joined the JWGD3 MILPERF program in 1984. The primary mission was to develop and evaluate a human performance assessment battery. The battery was to consist of a Level I Neurophysiological screen and a Level II Performance Assessment Battery (PAB).

The EMD mission with JWGD3 MILPERF has been successfully completed and this laboratory continues to support and contribute to the efforts of the Office of Military Performance Assessment Technologies (OMPAT), which succeeded the JWGD3 MILPERF.

A brief list of EMD's accomplishments are listed here and are elaborated in the YEARLY HIGHLIGHTS section below.

* Authored a performance assessment battery.

* Developed a neurophysiological performance assessment battery.

* Validated the batteries in a study of human performance during cold exposure.

* Employed the batteries as part of the JWGD3 MILPERF antihistamine validation effort.

* Transferred the PAB technology to JWGD3 MILPERF member laboratories and a number of universities.

* Participated in the Beta testing of the Unified Tri-Service Performance Assessment Battery (UTC-PAB) software system.

* Participated in the effort to generate standard test parameters for the individual tests of the UTC-PAB.

* Contributed two unique tests to the UTC-PAB library of tests.

* Participated in the generation of standard test parameters for the Neurophysiological test battery.

* Developed a model of pulmonary functioning under

stress using the MicroSAINT modeling environment.

* Enhanced the MicroSAINT modeling environment by developing procedures for the solution of differential equations.

* Monitored a contract effort to provide a task analysis of combat critical shipboard personnel occupational specialties.

YEARLY HIGHLIGHTS

FY 1984 (April 1984 - September 1984)

Progress consisted of (a) facilities/equipment, (b) test battery development, and (c) initiation of task analytic studies.

(a) Facilities/Equipment: With the acceptance of a new laboratory facility and computerized heat/cold environmental chamber and the purchase of ancillary test equipment, we developed the capability of conducting performance and physiological studies of thermal stress. The 15x15 ft programmable heat/cold chamber provided the capability of performing a full range of laboratory evaluations of behavioral and physiological performance.

(b) Test Battery Development: A neurocognitive/psychomotor assessment battery consisting of 31 repeated measures tests (with 15 alternate forms each) was developed and studies were initiated to establish standardized norms. Thirty subjects completed each of the tests, and normative data on acquisition, stability, and reliability were collected. This test battery was intended to allow a comprehensive evaluation of cognitive and psychomotor performance of individuals performing under potential stresses imposed by CW antidote/pretreatment agents.

(c) Task Analysis: A major portion of this work unit dealt with identifying ratings/jobs of shipboard personnel considered critical to combat mission accomplishment and who would be exposed to the contaminated environment during a CW attack.

Initial progress was as follows: Job task inventories of Navy ratings were acquired from the Navy Occupational Development and Analysis Center (NODAC). This information was further separated according to ship classification (e.g. DD vs CVN). Preliminary findings indicate that the following ratings are critical among combatant ships: Fire Control Technician (FT), Boatswain's Mate (BM), Gunner's Mate (GM), Signalman (SM), Missile Technician (MT), Master-at-Arms (MA), Quartermaster (QM), and Hull Maintenance Technician (HT).

FY 1985

Task Analysis: A formal contract package was constructed, delivered to the Office of Naval Research, and final negotiations were completed. Dr. Edwin Fleishmen and his associates from the Advanced Research Resources Organization (ARRO) have been selected to provide the required extramural support.

Level I (Neuropsychological Task Area Group) activities: The associate investigator (AI) was selected as Chairman for the Level I TAG, and through collaborative efforts within the TAG, major components for the standardized level I screen were designed, and prototypes produced. This included selected evoked potential paradigms and a section of automatic psychomotor tests. In addition, the AI has provided consulting services as a member of the review board assigned (by the JWGD3) to establish extramural support for the development of an automated neuropsychological assessment battery.

Level IIa (Cognitive Performance Task Area Group) activities: In cooperation with other TAG members a 25 test Unified Tri-Service Cognitive Performance Assessment Battery (UTC-PAB) was designed, and prototype components developed. In addition to the battery contents, a standardized hardware and operating system was developed for JWGD3 standardization.

Level IIb (Performance Physiology Task Area Group) activities: In collaboration with other members of the Level IIb TAG, a formal performance physiology battery was constructed. In addition, collaborative efforts with USUHS are underway to develop a mobile field laboratory to provide support for the initial residential screen to be conducted at ARC.

Progress from this work unit will be formally presented at the 1985 American Psychological Association convention (Los Angeles, CA) in the form of two poster presentations, and a presentation.

FY 1986

Task Analysis: A formal contract package was constructed, delivered to the Office of Naval Research, and final negotiations have been completed. Dr. Edwin Fleishmen and his associates from the Advanced Research Resources Organization (ARRO) providing the required extramural support and progress includes a special forces and shipboard task analysis.

Level I (Neuropsychological Task Area Group) activities: Through collaborative efforts within the TAG, major components for the standardized level I screen were designed, and prototypes produced. This included selected evoked potential paradigms and a section of automatic psychomotor tests (e.g. Zita and intentional tremor device). In addition, ESPC provided consulting services for the source selection board assigned (by the JWGD3) to establish extramural support for development of an automated

neuropsychological assessment battery.

Level IIa (Cognitive Performance Task Area Group) activities: In cooperation with other TAG members a 25 test Unified Tri-Service Cognitive Performance Assessment Battery (UTC-PAB) was designed, and a subset of prototype components developed. In addition to the battery contents, a hardware system was developed for JWGD3 standardization, and is currently being installed.

A subset of the UTC-PAB consisting of eight tasks, six of which were translated from existing cognitive performance PABS, and two of which were generated at NMRI was created. This subset is referred to as the NMRI-PAB. One of the tasks generated at NMRI (matching-to-sample) has been incorporated into the development of the UTC-PAB, the other task (repeated acquisition) is being submitted for consideration by the JWGD3 joint working group chairman for inclusion in the UTC-PAB. An "executive" program for controlling the NMRI PAB administration was also completed. The NMRI PAB was used to collect baseline data and estimates of the sensitivity of its constituent tasks was evaluated by manipulating task parameters.

Level IIb (Performance Physiology Task Area Group) activities: In collaboration with other members of the Level IIb TAG, a formal performance physiology battery was constructed. In addition, collaborative efforts with USUHS are underway to develop a performance physiology laboratory to provide support for the initial residential screen to be conducted at ARC. Additionally, the anticholinergic-autonomic tone review of literature was completed.

FY 1987

During FY87 this laboratory evaluated three separate revisions of Version 1 of the UTC-PAB software system. This required construction of a sample task in the configuration system and implementing its execution with the runtime system. At each stage in the configuration and runtime process the test constructors noted inaccuracies, inefficiencies, and failures in system operations. These findings were then incorporated into written reports which were forwarded to the Director, JWGD3 MILPERF for forwarding to the software contractor.

The NMRI-PAB was used to evaluate human performance in a Navy funded study evaluating the effects of acute cold exposure. Subjects were exposed to a temperature of 4 degrees C for a period of 90 minutes. Throughout the 90 minute period blood samples were taken. At minute 45 of the session the NMRI-PAB was started and the subjects performed on the PAB for approximately the next 30 minutes. The results indicated that for most subjects core temperature remained stable throughout the sessions. PAB performance however showed changes in accuracy and latency during

the exposures. In general, newly acquired behavior was more disrupted than well learned behavior and affected response latencies tended to be shorter. Measures of peripheral blood levels of epinephrine and norepinephrine were elevated in the cold but also showed an interactive effort with PAB performance in which the levels were significantly higher than they were preceding PAB performance.

Neuropsychology and PAB. The ability to simultaneously measure evoked potentials and performance on one task of the NMRI-PAB has been completed. By tying the evoked potential signal averaging equipment to the microcomputers used to manage PAB stimulus production and data acquisition, it is now possible to quantify cognitive evoked potentials relative to performance on a specific PAB task. With the use of 18 channel topographical analysis of cortical excitation, it appears that different stimulus conditions within the task produce evoked potentials with different scalp distributions.

FY 1988

During the reporting period this laboratory provided technology transfer and implementation support of the NMRI-PAB subset of the UTC-PA3 to the Naval Aerospace Medical Research Laboratory, Walter Reed Army Institute of Research, Georgetown University, the United States Army Aerospace Medical Research Laboratory, Diving Medicine Department - Naval Medical Research Institute, the University of Southern Mississippi, and the University of Massachusetts - Amherst.

The MicroSaint modeling environment was used to generate a model of cold exposure and physical stress effects on pulmonary functioning. The MicroSAINT system was also enhanced by the development of procedures for the solution of differential equations within the system.

A Performance version of the Repeated Acquisition test was developed for inclusion in the NMRI-PAB. Repeated Acquisition tests a subjects' ability to learn a new extended response sequence. The Performance version of this test evaluates a subjects ability to accurately repeat the same sequence of responses on numerous occasions for extended time periods.

The expanded version of the NMRI-PAB was used in a Navy funded study of cold exposure effects on human behavior and physiology. This study also included the use of Level 1 procedures to evaluate the effects of cold exposure on evoked potential latencies. The preliminary data from this study indicates a shortening of evoked potential latencies in the cold as compared to ambient temperature levels.

Evoked potential topographical mapping procedures were used

to evaluate the distribution of pattern reversal evoked potentials over the occipital pole. The distributions were found to be asymmetric for visual patterns of fine spacial structure. Papers have been submitted for publication from both of the evoked potential studies.

FY 1989

During the reporting period a study comparing the effects of antihistamine administration on the sensitivity of nine performance assessment battery tasks was undertaken and completed.

Objective:

This study was designed to provide experimental data validating a nine test subset of the UTC-PAB library of tests, as well as auditory and visual evoked potential tests from the NP-PAB library of tests. The evaluation was performed by administering therapeutic doses of diphenhydramine (Benadryl) or terfenadine (Seldane) prior to PAB administration. Diphenhydramine was chosen because of its purported central nervous system (sedative) effects, while terfenadine was chosen because of its purported lack of similar effects. The widespread use of antihistamines in military environments makes these compounds ideal candidates for the testing and evaluation of a militarily relevant performance assessment system.

Method:

The subjects were six adult males between the ages of 19 and 36 years. The subjects were medically pre-screened and were judged by a physician to be in good health. Following selection for the study the subjects were briefed on the experimental protocol by the Principal Investigator and given a copy of the informed consent form to read and sign. Each subjects blood pressure and heart was monitored following each experimental session and the subjects were not allowed to leave the premises until these measurements were within normal range. All subjects were compensated for their participation in the study.

The PAB tests used in this study were written in the QuickBASIC 4.5 programming language. The documentation details have been previously reported (1, 2). Performance assessment battery administration was automated on a Zenith 150 series micro computer system. Data were recorded for accuracy and latency of responding for each trial of the tests.

The evoked potential procedures evaluated were the pattern reversal evoked potential and auditory event related potential measurements.

Procedure:

The study consisted of two phases, a training phase and an experimental phase. During the training phase each subject was

given one or two sessions of training with a demonstration version of the PAB. This version contains a screen of instructions that precedes each PAB test, the number of trials in each test is reduced, the subject receives auditory feedback for each correct response, and the transition from test to test is self-paced. No data were collected during these training sessions.

The next phase of training consisted of six to nine sessions with a training version of the PAB. During these sessions the full number of trials for each test was employed, the subject received feedback for correct responses, and the transition from test to test was machine controlled with a 20 second inter-test-interval between test presentations. These sessions required approximately thirty minutes to complete, and subjects were required to perform the PAB two or three times each day. Data collection was initiated during these sessions.

The final phase of training was identical to the experimental phase of the study, excluding drug administration. During this phase the subjects performed three PAB sessions, spaced at hour intervals, each day they visited the laboratory. The version of the PAB used did not include feedback for either correct or incorrect responses. This phase of training lasted until each subject achieved a criterion of 90% correct or better on each test for three sessions.

The experimental phase of the study consisted of nine sessions. Each subject was administered either 100 mg of diphenhydramine, 60 mg of terfenadine, or placebo three times each in a mixed order. Drug was administered and sessions occurred at 1 hour, 2 hours, and 3 hours post drug administration. Evoked potential measurements were conducted between the second and third hour of PAB testing. Drug administrations were spaced at least 48 hours apart. All experimental sessions took place between the hours of 0800 and 1200. The subjects were alone and restricted to the testing room for the duration of the sessions but were allowed to read or listen to a radio between sessions. The initiation of each session was controlled by an investigator.

Results:

The data were analyzed for changes in both accuracy and latency of responding. Data analysis indicated interactions between treatment and hour of testing for accuracy of responding during the Chain Performance, Manikin, and Simultaneous Pattern Comparison tests of the PAB. An inspection of the data revealed that accuracy of responding in the diphenhydramine condition was reduced during these three tests. A level of significance of .01 or better was obtained with these data. Analysis of the latency data revealed changes with similar significance levels occurring during the Repeated Acquisition test following diphenhydramine administration. No consistent changes were observed in any condition following terfenadine administration.

Analysis of the evoked potential data revealed greater intra-

subject variability in both the pattern reversal evoked potential and the auditory event related potential following diphenhydramine but not terfenadine administration. There were no changes in either the latency or amplitude of the response following administration of either drug.

Conclusions:

Three of the nine tests comprising the PAB proved to sensitive to diphenhydramine but not to terfenadine when accuracy of responding was measured. One of the tests proved to be sensitive to diphenhydramine but not to terfenadine when latency of responding was measured. The majority of effects observed during diphenhydramine administration occurred during the second or third hour of testing. This is in conformance with the reported pharmacokinetics of diphenhydramine. Given orally this drug reaches maximal concentration in the blood in about two hours and remains at that level for another two hours.

During the reporting period this laboratory provided technology transfer and implementation support of the NMRI-PAB subset of the UTC-PAB to the Addiction Research Center, NIDA, Baltimore, MD, the Naval Submarine Medical Research Laboratory, Groton, CN, the University of Massachusetts - Amherst, and the ARD Corporation, Columbia, MD.

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